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# Technology Opportunity

Technology Transfer & Partnership Office

TOP3-00166

## Technique to Transition Between Coating Layers With Different Coefficients of Thermal Expansion (CTEs)

### Technology

A technique designed to transition between an environmental barrier coating (EBC) layer with a low CTE and a thermal barrier coating (TBC) layer with a high CTE.

### Benefits

This technology reduces the thermal stresses between coating layers with different CTEs, which leads to

- Coatings that last longer, leading to less engine maintenance
- Improved performance of the engines using these coatings

### Commercial Applications

This technology can be used in gas turbines incorporating ceramic components:

- Aerospace gas turbine engines
- Gas turbines for industrial applications

### Technology Description

There are two main types of coatings applied to gas turbine components:

- EBCs provide a protective barrier to prevent water vapor from contacting the underlying material
- TBCs reduce the temperature seen by the underlying material

370hr, 1400 °C, 1-hr cycles, 90-percent H<sub>2</sub>O

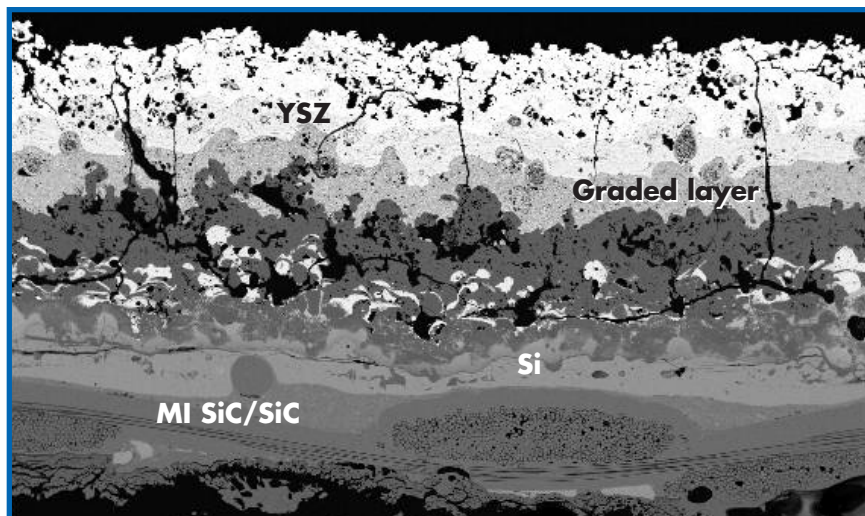


Figure 1.—Silicon/graded mullite+YSZ/YSZ.

As described in TOP3-00165, ceramic engine components have a low CTE, which require an EBC with a low CTE. However, the best available TBC, yttria-stabilized zirconia (YSZ) has a high CTE, so a technique that reduces the thermal stresses that form between these layers is required to transition from the EBC to the TBC.

A technique developed at the NASA Glenn Research Center successfully transitions between an EBC with a low CTE and a TBC with a high CTE. The technique involves applying multiple layers of "graded" blends of the EBC and TBC materials to form a transition zone to reduce the stress between the two layers. Figure 1 is a cross section of a ceramic component, showing the graded layers between the YSZ layer on the top and the underlying EBC layer. This technique is depicted graphically in Figure 2. Starting with a layer of pure EBC material, each subsequent layer includes more YSZ material, so after three transition layers, a layer of pure YSZ can be applied.

Transition zone {	Composition	CTE
	YSZ	High
	EBC<YSZ	Medium-high
	EBC≈YSZ	Medium
	EBC>YSZ	Low-medium
	EBC	Low

Figure 2. — Chart showing transition zone from pure EBC to pure YSZ.

## Options for Commercialization

There is a patent application in process for this technology. NASA is seeking companies interested in applying this technology to commercial applications.

## Contact

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## References

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## Key Words

Silicon carbide matrix composite  
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